

Splicing

Optical fibre is used as transmission media for data communication. In general, for any line communication, transmission media has a requirement of both joining and terminating the connection. Proper fibre-to-fibre connection is required so that there is very low loss with minimum signal distortion. Fibre joining is analogous to the joining of electrical wire. In general, to join the wire either of electric or telephone line, the broken edges are twisted together or we either solder the broken edges of wire to join the wires together. But in case of optical fibre cable (OFC), two fibre cables are joined together by a method, known as splicing. Hence, splicing is the method in which broken fibre ends are joined permanently. Splicing is nothing but a sort of noble name of “soldering”. The sophisticated term of splicing is used with fibre optics since these cables carry light signal and not the electrical signal. The OFC consists of a core through which the light propagates. Hence, joining the OFC cables requires proper core-to-core alignment so that light can pass through it without any leakage. In this chapter, we will study the method of splicing.

Soldering the broken wire at home

Wire is commonly used to connect the parts of an electrical circuit at home to use various appliances like tube light, bulb, etc. The wire must extend from surface to surface, and if not protected properly from external climatic conditions, accidental breakage might lead to the damage of the wire hence interrupting the work of electrical appliances. If a wire becomes damaged, it does not necessarily need to be replaced. The circuit may be restored by soldering it. The broken wires can be joined by cutting, stripping, soldering and then covering by the tape.

Requirement of splicing

Fibre cables are widely applied in today's communication network. They are buried under the street or under the sea. Fibre cables are quite indispensable for information transmission and data providing. They are just like the veins of communication systems. Once fibre cables are damaged or cut, network will be interrupted. Since optical fibre cable is made up of glass it requires repairing if broken or damaged. The repairing done to join the damaged cable is not same as the repairing or soldering done on the electrical wires at home. It requires specialised technique to join the damaged optical cable because the cable of optical fibre is composed of glass. This technique of joining the fibre optics cable is called splicing. Splicing is a costly method of repairing the fibre. It requires expensive machines and technicians to repair. Fig. 5.1 shows a damaged cable.



Fig. 5.1: Damaged fibre

Factors affecting OFC

There are various factors that lead to the damage of fibre optics cable.

In the telecommunications industry, we focus a lot on how to build our fibre optic outside plants quickly and efficiently while providing a highly functional network. What happens to that buried fibre after the heavy equipment and construction crew leave? Several factors can destroy buried fibre optic cable and interrupt network traffic, triggering significant repair costs and lost revenue. The various factors affecting OFC are —

- Water
- Rodents
- Lightning or Incidental Voltage
- Construction
- Ice Crush

Water

Water is very harmful for fibre optic strands. Modern-day fibres benefit from advanced coatings that protect them from water, except in the splice enclosures where the tips of the fibre strands are stripped off their coatings so the splices can be fused without contaminants. Today, most water damage happens in splice enclosures that have failed to keep water away from the fibre.



Fig. 5.2: Damage in splice enclosure due to water



Fig. 5.3: Damage in fiber cable due to rodents

Rodents

Since they have a life-long drive to gnaw, rodents are often responsible for extensive damage to fibre optic cable. Even metal armoured cable can get cut in two by these furry creatures.



Lightning or incidental voltage

When lightning strikes the ground, it searches for the best conductor available, even if it is underground. If that happens to be the armour or trace-wire of your fibre cable, then damage to the cable sheath and even the fibre itself is very likely (Fig. 5.4).

Construction

Construction can be the biggest cause of damage to buried cable. Backhoes, post hole augers and even hand shovels can all bring network traffic to a halt by severing your fibre optic cable (Fig. 5.5).

Ice crush

In colder climates, water that enters a splice enclosure can freeze, crushing the fibre strands and leaving you with a costly network outage. When ice crush occurs, an emergency network repair is needed to avoid additional damage and downtime. Given the harsh conditions, however, access to the splice enclosure is often very hard to reach. In such scenarios, it is not uncommon to find the handhole buried under a snowbank, with the lid frozen shut, and full of water that has completely frozen. (Fig. 5.6).

Assignment: Classify the factors effecting the damage of the cables by natural and man-made reasons on table below.

Factors	Man-made	Natural
Ice crush		
Thunderstorm		
Fire		
Squirrel, rats, insects		

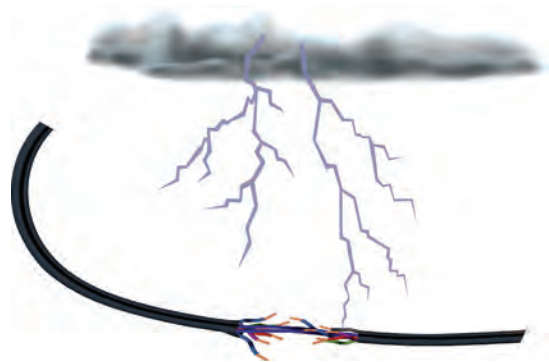


Fig. 5.4: Damage in fiber cable due to lightning



Fig. 5.5: Damage to the fibre cable due to construction



Fig. 5.6: Damage to the fibre cable due to ice crush

NOTES

Nuclear radiation		
Factory smoke and air pollution		
Construction of site		
Salt water, moisture		
Temperature change		
Earthquake		
Traffic (cars, trucks)		
Nuclear radiations		

Types of splicing

Splicing can be divided into the following two types—

- Fusion splicing
- Mechanical splicing

Splicing can be performed in two ways either mechanically or electrically. If splicing is done mechanically it is called mechanical splicing. But if splicing is done electrically it is called fusion splicing. Fusion splicing is done by heating the ends of the fibre using electric arc. It is useful to join the fibre ends permanently together. It has lower attenuation loss of 0.1dB/km. In mechanical splicing, the joint is temporary and has loss between 0.2 to 0.72dB/Km, which is more than fusion splicing.

Steps to perform fusion splicing

Practical Activity 1: Fusion Splicing using Electric Arc Method

Material required

- Optical fibre ends to be spliced
- Optical fibre splice machine
- Optical fibre cleaver
- Tissue paper
- Alcohol
- Protection sleeves
- Round tube cutter
- Fibre cutter/stripper
- OTDR (Optical time domain reflectometer)



Procedure to be followed

Preparation

Step 1: Fibre Preparation

First take the damaged fibre to be spliced as shown in Fig. 5.7.

Note: It is mentioned on the cable fibre whether it is designed as single mode or multimode. Based on it the necessary setting is on the fibre splicing machine to carry out the splicing.

Prepare the fibre cable for splicing: For preparing the cable to be spliced break the fibre at damaged area into two parts using pliers shown in Fig. 5.8.

Now prepare each end perfectly so that both broken parts of the fibre can be joined/spliced perfectly core-to-core without any losses. Fig. 5.9 shows two parts of cable to be prepared for splicing.

Step 2: Clear the damaged area

Now take any one of the broken parts of the fibre cable out of the two parts (shown in previous step). Now we will illustrate Step 3 onwards for only one broken end since all the steps for the other broken end is repeated in a similar way.

Step 3

Take a round cutter and put the fibre inside its round jaws at a distance of around 3 to 5 inches away from the end of the cable to remove its jacket part. Rotate it twice or thrice around the cable. A round cut mark is formed on the cable. Now push the jacket with your finger towards fibre end to remove it as shown in Fig. 5.10.

Discard the jacket of the fibre in dustbin (shown in Fig. 5.11)

Now you will be left with the coating of the tube around the fibre as shown in Fig. 5.12.



Fig. 5.7: Damaged fibre cable



Fig. 5.8: Breaking damaged fibre using pliers



Fig. 5.9: Fibre cable for preparation



Fig. 5.10: Working of round cutter on the fibre



Fig. 5.11: Throwing waste jacket of the fibre in dustbin



Fig. 5.12: Coating of tube around the fibre

NOTES

Take a stripping tool and place the fibre inside it to remove the tube shown in Fig. 5.13 and 5.14.



Fig. 5.13: Stripping tool removing the fibre tube



Fig. 5.14: Fibre after tube removal

Now take a tissue paper with little alcohol poured on it to clean the jelly above the bunch of fibre shown in Fig. 5.15.



Fig. 5.15: Removal of the jelly around bunch of fibres with tissue paper

Finally you are left with hair-like thin long fibres of different colours (in set of 12 bunches of multiples of 12 like 24, 36 fibres) shown in Fig. 5.16.

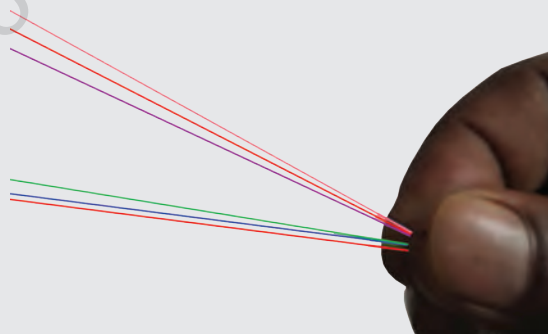


Fig. 5.16: Hair type fibre of different colours



Fig. 5.17: Single fibre to be spliced

Take any one fibre of any colour, say, red. Now use for splicing this fibre (Fig. 5.17).

Step 4: Placing the protection sleeve over the fibre

Take a 60 mm protection sleeve and put the single hair-like red colour fibre inside it. Move it around 5 inches backward from the end of the fibre (shown in Fig. 5.18). As already studied in the previous unit, protection sleeve contains inner tube (hot-melt glue) and strength member. The hot-melt adhesive in the inner tube bonds to both the fibre and the heat shrinkable outer tube to encapsulate the fusion splice joint and provides vibration damping and an environmental seal, protecting the fibre from damage and contaminants. Strength member (stainless steel, ceramic or non-metallic) provides additional rigidity to prevent misalignment, micro bending or breakage of the fibre.

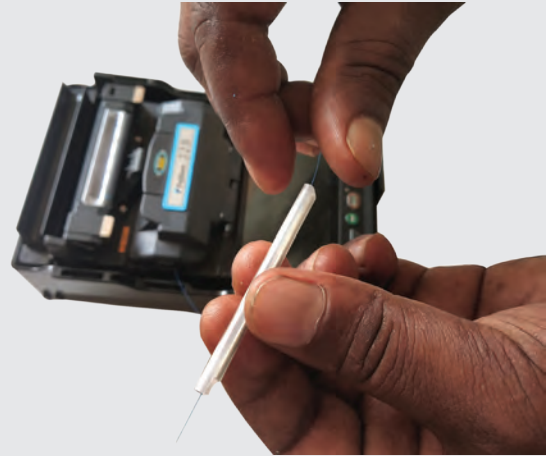


Fig. 5.18: Placing protection sleeve inside the fibre

Step 5: Stripping the fibre

Take the stripping tool and put this red single fibre inside its first slot. This will remove the buffer and now you are left with the tube/cladding inside the jacket as shown in Fig. 5.19.

Again take the stripper and put the cladding part inside the third slot of the stripper. This will reveal the core part with jelly above it.

Note: You will find a transparent sticky jelly below the core. Don't touch this jelly directly with hands. Take a clean dry tissue and use it to wipe off the jelly shown in Fig. 5.20.

Again, take a tissue and wet it with a few drops of alcohol and clean the core once again so that no dust is left above the core as shown in Fig. 5.21.



Fig. 5.19: Removing buffer using stripper



Fig. 5.20: Cleaning the jelly with dry tissue

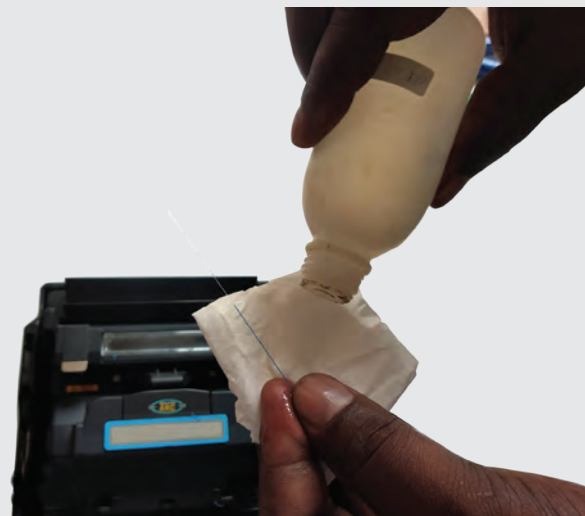


Fig. 5.21: Cleaning the jelly with tissue and alcohol

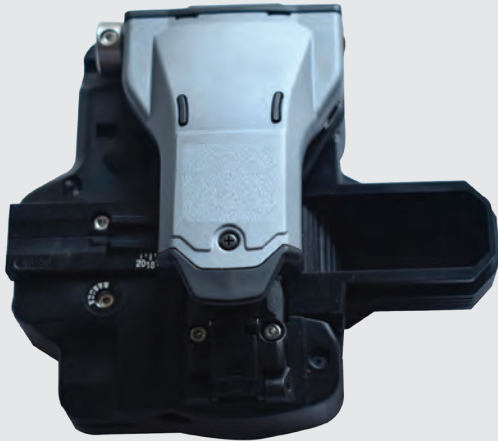


Fig. 5.22: Precise cleaver

Note

- It is necessary to clean the fibre so that the dust cannot enter inside the protection sleeve which can result in attenuation.
- Don't touch the bare fibre with hands. The glass on the fibre can cut the fingertip.

Step 6: Cleaving the fibre

Take the precise cleaver and place the cleaned thin hair-like core of the fibre inside it as shown in the Fig. 5.23(a). The round diamond blade cutter is suitable for cutting the fibre. Exactly 50 degree of cleaving is done in which core part of the fibre in the machine is kept horizontally and the machine blade cuts the fibre end vertically. This gives very accurate cut. It involves three steps—

- (a) Place the fibre in the cleaver
- (b) Adjust the blades
- (c) Finally cleave it by pressing the cap above (Fig. 5.23(b))

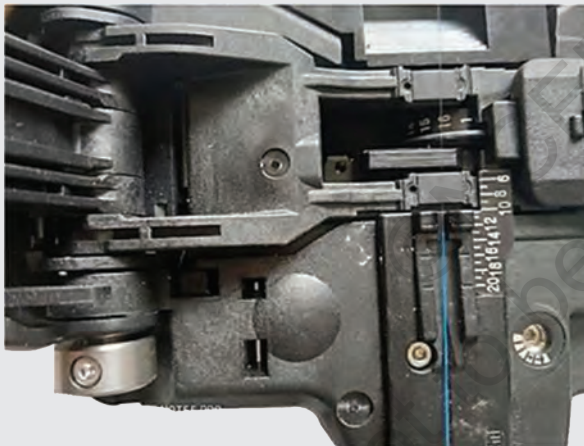


Fig. 5.23(a): Place the fibre in cleaver and adjust the blades



Fig. 5.23(b): Cleave it by pressing cap

Precautions to be taken

- Don't place your finger inside the cutter
- Wear hand gloves
- The cleaved or cut extra portion of the fibre has to be carefully put inside the dustbin. When optical fibres are cleaved, fibre scraps with extremely sharp ends are obtained. They may stick to a finger and can then be transported into the eyes. They can also easily penetrate the skin and are hard to pull out. Fibre scraps should also not be ingested. For such reasons, it is important to carefully dispose the optical fibre scraps into a properly marked container before they get lost.

Step 7

The other end of the fibre is also prepared using the same steps from 3 to 7 except step 5, i.e., don't put protection sleeve above the fibre. Only one protection sleeve is enough for one single fibre splicing process.

Step 8: Operation with splicing machine

Optical fibre splice machine is used for fusion splice. The machine has two steps of operation. Firstly, it aligns the cores of the two fibres to be joined and then the two electrodes inside it performs fusion of the fibre. The splicing machine is shock resistant, dust resistance and rain resistance. It is easy to handle. It performs total splicing operation in less than a minute. It produces high quality of spliced fibres with an attenuation loss less than 0.1db/km. Due to high precise work the cost of machine is high.

Components and parts of the machine

Fig. 5.24 shows the different components and parts of the machine with each part responsible for the complete splicing procedure. It is a small, lightweight machine with an LCD screen. This screen shows the splicing operation and internal view of the operations performed in machine. LCD screen shows process of alignment and the fusion operation going inside the machine. The keypads on the machine help in the initial settings.

Practical Activity: Steps of working with the fusion splicing machine

1. Switch on the splicer machine using the ON/OFF button. This machine can be operated with the help of the pluggable lithium battery or 230V AC power supply also. The word "Ready" is displayed on the LCD screen of the splicer machine indicating that machine is ready for operation. Whether the battery is charged or discharged is also indicated on the screen.

Fig. 5.25 shows the LCD screen of the machine.

Switch to turn OFF and ON



Fig. 5.25: LCD screen after machine is turned ON



Fig. 5.24: Components and parts of the splicing machine



Adjustment of the brightness of LCD screen

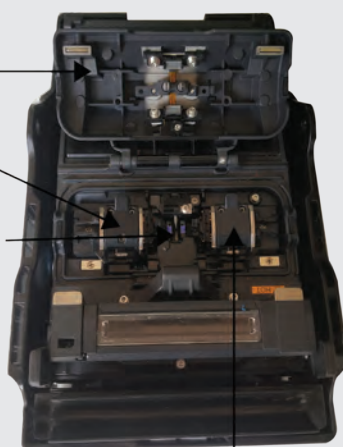
LCD Display of the Machine

Fig. 5.26: LCD Display

Opening of the
wind protection
lid

Clamp 1

Internal machine
where fusion is
done



Clamp 2

Fig. 5.27: Internal view of the machine

Opening
of the
clamp 1

Placing
of the
fibre
inside
the
machine

V-Groove



Fig. 5.28: Placing the fibre inside the machine

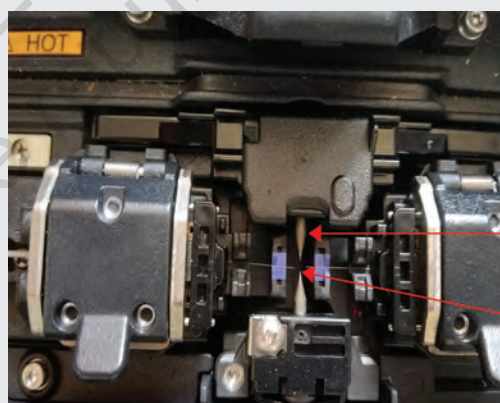


Fig. 5.30: Fixing the fibre inside the machine by closing the left clamp

Read the screen which shows the following modes of operation:

SM Auto: This tells that the machine is working with single mode fibre. 60 mm SS and SLIM 60 indicates the heating mode of protection sleeve of 60mm.

2. LCD Brightness adjustment: After the splicing machine is powered on with the “Ready” interface, press [] [] button for brightness increasing or decreasing indicator and press Key.
3. Open the wind protector and clamps and you will see the internal part of the machine where fusion is done (as shown in Fig. 5.27). After opening the wind protector there are two electrodes that are responsible for splicing as shown in the Fig. 5.27.
4. Place the first end of the prepared fibre of Step 6, inside the V-groove so that the tip of the fibre is located between V-groove edge and the tip of the electrode as shown in Fig. 5.28 and Fig. 5.29.



Electrode

Placing
fibre
between
electrode

Fig. 5.29: Placing fibre between the electrodes

Note: While placing the fibre, the distance between the electrode and cable placed should be equal.

5. Hold fibres with fingers and close the sheath of left clamp (shown in the Fig. 5.30) so that it does not move. Make sure that the fibre is placed at the bottom of the V-groove. If the fibre is not placed properly then reload the fibre.

6. Prepare the second fibre to be joined then repeat the steps of placing the fibre inside the machine. Lift the right clamp and place the fibre end inside it and finally close the clamp as shown in the Fig. 5.31.

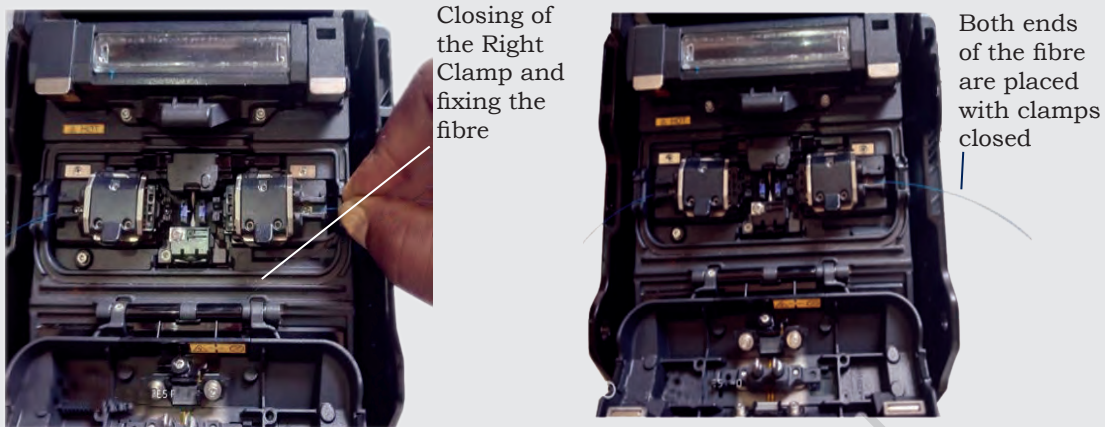


Fig. 5.31: Fixing the fibre inside the machine by closing right clamp

7. Finally Fig. 5.32 shows that both ends of the fibres are placed and both left and right clamps are closed.
8. After the two ends of the fibre are fixed inside clamps, close the wind protector as shown in the Fig. 5.33.

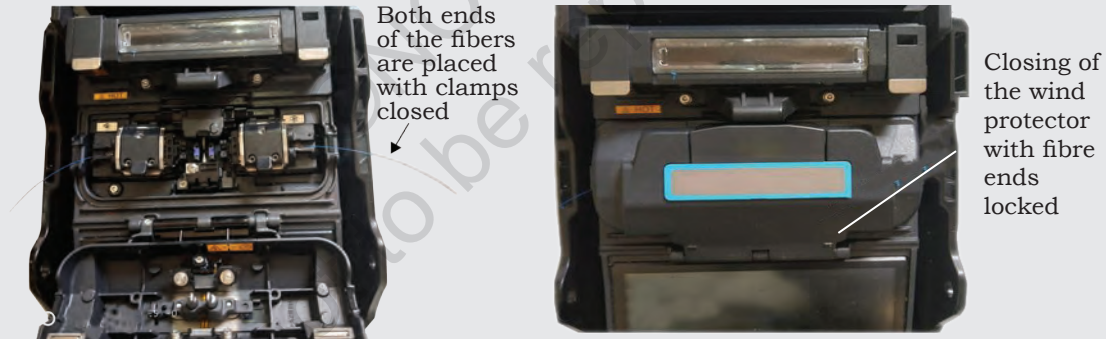


Fig. 5.32: Both ends of the fibre are placed and both left and right clamps are closed

Fig. 5.33: Closing the machine with fibre ends locked inside it

9. To assure good splicing (with minimum attenuation loss), operation taking place inside the wind protector can be seen on the LCD screen. Visual inspection with monitor is very important for good splicing.
10. After the fibre ends are locked inside the wind protector, press the **SET** button on the keypad. Core-to-core alignment is done. This can be visualised on the LCD screen shown in Fig. 5.34(a). If abnormal splice is detected as fat, thin, or with a bubble an error is displayed. If no error is displayed but the splice looks poor visually then repeat the whole step of

placing fibre inside the machine. Now press the **ARC** button after fibre is aligned properly to perform fusion shown in Fig. 5.34.



Fig. 5.34(a): Pressing the set button



Fig. 5.34(b): Core-to-core alignment of fibre



Fig. 5.34(c): Core aligned perfectly



Fig. 5.34(d): Fusion splicing of fibre

Note: After the fibre is spliced the amount of attenuation loss is calculated on the screen showing the level of accuracy of the splicing. If attenuation is 0.00 dB, it means splicing is perfect with no loss. Attenuation from 0.00 dB to 0.02 dB is acceptable. If attenuation value the about 0.002 dB the splicing operation needs to be repeated.

11. The result is saved in splicing memory.

Step 9: Protecting the fibre

12. Open the wind protector. After splicing, open the left sheath clamp and the right clamp together to remove the spliced fibre (shown in the Fig. 5.35).

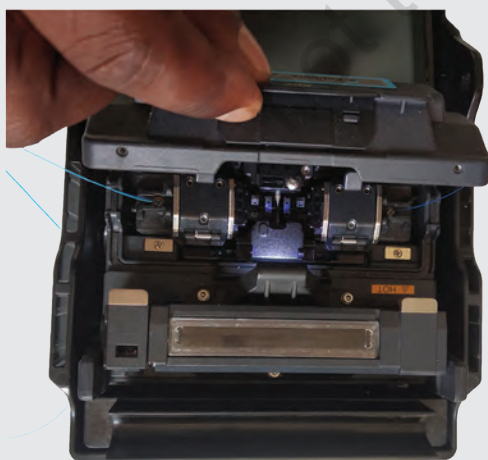


Fig. 5.35(a): Opening the lid of the machine

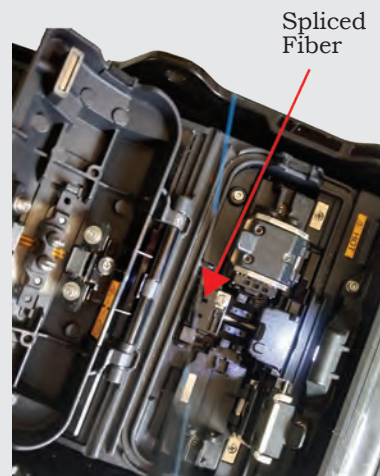


Fig. 5.35(b): Removing spliced fibre from the machine

13. Now slide the protection sleeve (of step 5) to the centre of the splice joint as shown in Fig. 5.36.

Heating the protection sleeve

14. Open the tube heater lid. Place the joined fibre with protection sleeve inside the tube heater as shown in Fig. 5.37.
15. Now transfer the fibre with protection sleeve from the splicer to the tube heater and close the lid of tube heater shown in the Fig. 5.38.

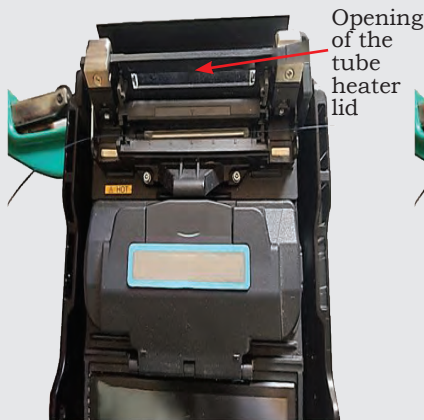


Fig. 5.37: Placing the spliced fibre with protection sleeve inside the tube heater

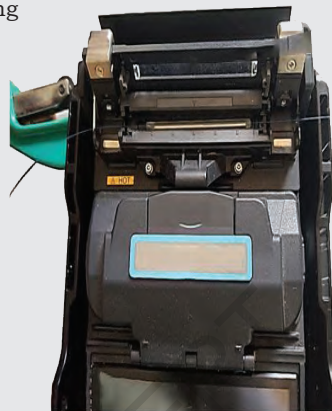


Fig. 5.38: Locking protection sleeve with spliced fibre inside the tube heater

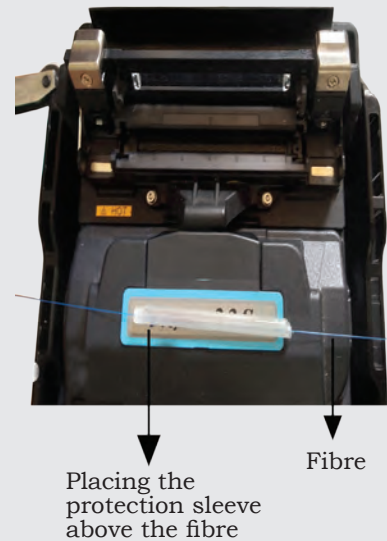


Fig. 5.36: Placing the protection sleeve above the spliced fibre

Note: Make sure that the splice point is located in the centre of the protection sleeve.

16. The heat shrink activity starts by pressing the key [HEAT] while closing the tube heater. A buzzer beeps for 1-2 seconds indicating the completion of the process.
17. Open the lid of the tube heater and remove the protected sleeve from inside, as shown in the Fig. 5.40. Apply some tension to the fibre while removing it from the tube heater.



Pressing heat button

Fig. 5.39: Pressing heat button

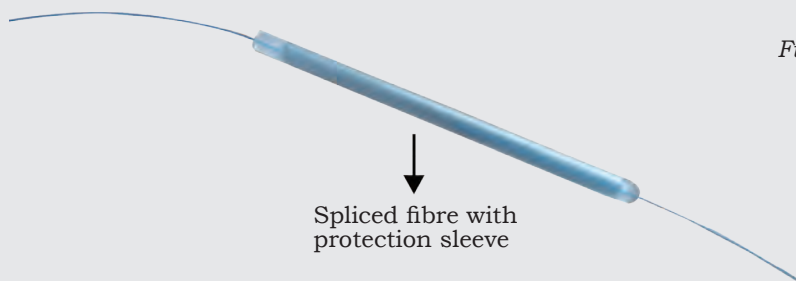


Fig. 5.40: Spliced fibre with protection sleeves

Note

- Visually inspect the shrunk finished sleeve to verify the quantity of bubbles or dust in the sleeve.
- Protection sleeve may stick to bottom plate of the heater. Use cotton swab to remove the residue.

In this way all the fibre to be joined are prepared by performing the splicing operation and organised together.

Step 10: Testing

Finally, the fibres are tested and its performance is measured using OTDR. The readings of OTDR confirm that of all fibre, attenuation is within specified limits. Testing determines that fibres were not subjected to excessive stress during the organising process.

Practical Activity 2: Perform mechanical splicing

Material required

- Optical fibre ends to be spliced
- Optical fibre mechanical splicer connector
- Fibre optic cleaver
- Tissue paper
- Alcohol
- Protection sleeves
- Round tube cutter
- Fibre cutter/stripper
- OTDR (Optical time domain reflectometer)

Procedure to be followed

Follow the steps from 1 to 7 for mechanical splicing. Only difference is that protection sleeve and method of heating the end of the fibre is not applied.

Note: Heat or electric arc is not used in fusion splicing. Instead in mechanical splicing the fibre is simply connected together by the following steps—

1. The fibre parts are placed in a ferrule.
2. A ferrule is a capillary glass tube under compression with the help of a spring.
3. Inside the ferrule the fibre is properly inserted into the sleeve as shown in Fig. 5.41.
4. This type of splicing is done in multimode fibres.
5. The index matching gel is placed inside the mechanical splice apparatus.
6. This gel helps to couple the light from one fibre end to the other.



Fig. 5.41(a): Mechanical connector

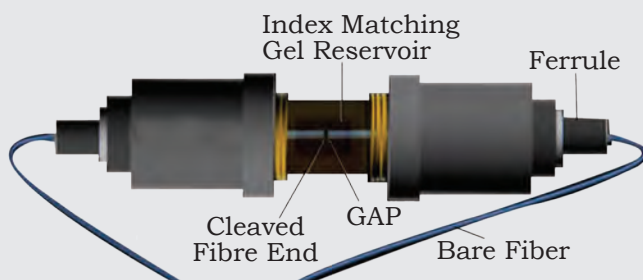


Fig. 5.41(b): Mechanical connector

Testing of splicing

NOTES

Mechanisms of light loss at optical fibre joint

When joining optical fibres, the opposed cores must be properly aligned. Optical fibre connector/splice loss occurs mostly due to the following—

Poor concentricity

Poor concentricity of joined optical fibres causes a connector/splice loss. In case of general-purpose single-mode fibres, the value of connector/splice loss is calculated roughly as the square of the amount of misalignment multiplied by 0.2. For example, if the light source wavelength is 1310 nm, misalignment by 1 μm results in approximately 0.2 dB of loss.



Fig. 5.42: Splice loss due to poor connectivity

Axial run-out

A connector/splice loss occurs due to an axial run-out between the light axes of optical fibres to be joined. For example, it is necessary to avoid an increased angle at fibre cut end when using an optical fibre cleaver before fusion splicing, since such an angle can result in splicing of optical fibres with run-out.



Fig. 5.43: Splice loss due to axial run-out

Gap

An end gap between optical fibres causes a connector/splice loss. For example, if optical fibre end faces are not correctly butt-joined in mechanical splicing then it results in a splice loss.



Fig. 5.44: Splice loss due to gap

Reflection

An end gap between optical fibres results in 0.6 dB of return loss at the maximum due to the change in refractive index from the optical fibre to the air. Cleaning optical fibre ends is important for optical connectors. In addition, the optical connector ends should be cleaned because loss can also occur due to presence of dirt between.

Factors that are considered to have good splicing

1. Fibre ends must be cut perpendicular to the length of the fibre. Some cleaving devices are there which produce quite clean and ready-to-use fibre cuts.
2. Just after the end preparation, splicing must be done to avoid dust accumulation on the cleaved ends which will cause loss of a part of light energy at the splicing point.
3. Jackets of the fibre are to be cut lengthwise without scoring the fibre, to get the bare fibre.
4. If jackets are cut longitudinally, it will allow them to be pulled back and forth, to expose the buffered fibre.
5. A chemical or a special stripping must be used to remove the buffer. If a chemical is used for the removal of buffer, it should be removed quickly otherwise it may damage the fibre.
6. Follow the splicing instructions provided by the manufacturer of the splicing equipment and fibre.
7. Splicing is visually inspected. During the process of splicing, optical fibres can cause white or black lines in the spliced region which is not considered as faults.
8. Method of fusion splicing provides a high-quality of permanent joint with very less loss of light (in the range of 0.00 dB to 0.02 dB for single-mode fibres).

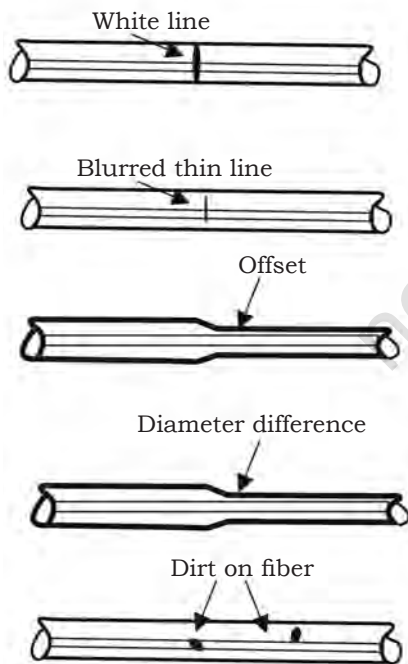


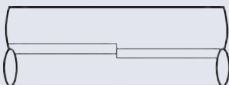
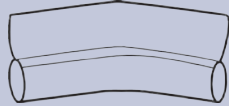
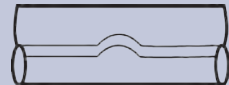
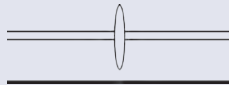
Fig. 5.45: Good splicing

Factors that are considered for bad splicing

During the splicing process, some errors might occur which are not acceptable. This requires the splicing process to be repeated. Sometimes black spots or lines are created in the fibre and can be improved by repeating the whole process of splicing. For large core offsets, bubbles, or bulging-splice, method of splicing is repeated again (Fig. 5.46).

Troubleshooting Splicing Errors

Here are some common problems and likely causes.

Symptom	Cause	Remedy
Core axial offset 	Dust on the V-groove or fibre clamp chip.	Clean V-groove and fibre clamp chip.
Core angle 	- Dust on the V-groove or fibre clamp chip. - Bad fibre end-face-quality.	- Clean V-groove and fibre clamp chip. - Check if fibre cleaving is done properly.
Core step 	Dust on the V-groove or fibre clamp chip.	Clean V-groove and fibre clamp chip.
Core curve 	- Bad fibre-end face quality. - Pre-fuse power is too low or pre-fuse time is too-short.	- Check if fibre cleaving is done properly. - Increase pre-fuse power and pre-fuse time.
Bubbles 	- Bad fibre-end face quality. - Pre-fuse power is too low or pre-fuse time is too-short.	- Check if fibre cleaving is done properly. - Increase pre-fuse power and pre-fuse time.
Combustion 	- Bad fibre-end face quality. - Presence of the dust is still there after cleaning fibre or cleaning arc.	- Check if fibre cleaving is done properly. - Cleaning the fibre ends thoroughly or increasing the cleaning arc time.

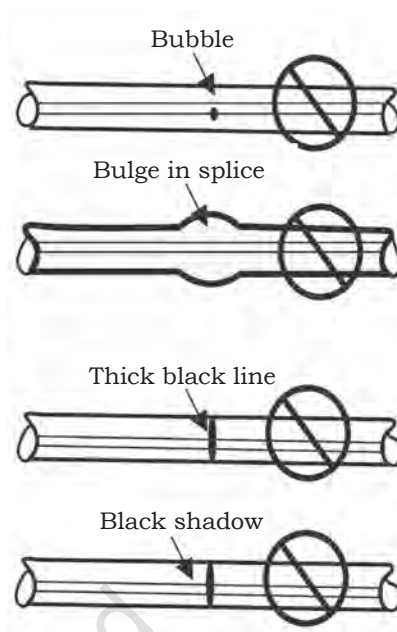
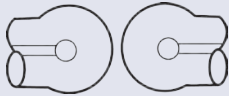
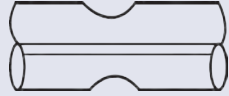


Fig. 5.46: Bad splicing

NOTES

Separation 	• If electrodes are contaminated. • Electrodes and the fusion current are very high.	• Increase pre-fuse power and pre-fuse time.
Fat 	• Auto feed too fast, Incorrect current.	• Increase pre-fuse power and pre-fuse time.
Thin 	• This type of problem is present when current is high and feed rate is very low. Contaminated electrodes, pre-fusion time span is also too long, pre-fusion current is too high, gap is too wide.	• Increase pre-fuse power and pre-fuse time.
Line 	• Fusion current is very less- pre-fusion time is very short.	• Increase pre-fuse power and pre-fuse time.

Check Your Progress

A. Multiple Choice Questions

1. A permanent joint formed between two different optical fibres is known as _____.
 (a) fibre splicing
 (b) fibre connector
 (c) fibre attenuator
 (d) fibre dispersion
2. Method of fusion splicing is done by _____.
 (a) electric arc
 (b) heating
 (c) fusion
 (d) All of the above
3. Cleaving means _____.
 (a) cutting the fibre edges
 (b) polishing the fibre ends
 (c) cleaning the fibre
 (d) All of above



4. The loss of light in fusion splicing compared to mechanical splicing is _____.
 - (a) equal
 - (b) greater
 - (c) less
 - (d) None of above
5. Mechanical splicing is also known as _____ splice.
 - (a) V-Groove
 - (b) elastic tube
 - (c) rotary
 - (d) Both a and b
6. Fibre joined using the mechanical splicing are _____.
 - (a) temporary joints
 - (b) permanent joints
 - (c) loosely joined
 - (d) partially joined
7. While comparing mechanical and fusion splicing we see _____.
 - (a) fusion splicing is more accurate than mechanical splicing.
 - (b) mechanical splicing is more accurate than fusion splicing.
 - (c) both mechanical and fusion splice are accurate.
 - (d) mechanical splicing and fusion splicing are inaccurate.
8. Core diameter mismatch loss occurs when _____.
 - (a) the diameter of the transmitting core is greater than that of the receiving core.
 - (b) the diameter of the transmitting core is less than that of the receiving core.
 - (c) the diameter of the transmitting core is not precisely aligned with the diameter of the receiving core.
 - (d) the diameter of the receiving core is at the lower end of the acceptable size range.
9. Cladding diameter mismatch loss happen when _____.
 - (a) the cladding diameter of the transmitting fibre is larger than the cladding of the receiving fibre.
 - (b) the cladding diameter of the transmitting fibre is smaller than the cladding of the receiving fibre.
 - (c) the cladding diameters of the fibres do not match.
 - (d) the cladding diameters of both fibres are slightly larger than normal.



NOTES

10. If the transmitting and receiving cores are offset from their cladding in different directions, the result may be _____.
 - (a) concentricity loss
 - (b) centrality loss
 - (c) lateral offset loss
 - (d) slip loss
11. If the transmitting and receiving cores are slightly oval, the splice may experience _____.
 - (a) symmetrical loss
 - (b) asymmetrical loss
 - (c) oval loss
 - (d) None of the above

B. Fill in the Blanks

1. Mechanical fusion provides the loss of _____ dB.
2. Fusion splicing provides loss of _____ dB.
3. Fibre end must be cut _____ to the end of the fibres.
4. The fusion one provides a lower level of _____ and a higher degree of _____ than mechanical splicing.
5. Full form of OTDR is _____.
6. Fibre cleaning is done by _____ method.

C. Answer in Brief

1. What is splicing?
2. What is cleaving?
3. How to clean fibre during splicing?
4. Name the tool used for cleaving.
5. Why is diamond used as cutting agent in the tools used for cleaving?
6. What are the basic methods used for splicing?
7. Compare different splicing techniques.
8. What are the advantages of placing optical matching cement?
9. Write the steps involved in splicing.
10. How to repair a broken fibre?
11. What is mechanical splicing?
12. Which solution is used for cleaning fibre?
13. Differentiate between splicing a fibre and joining two copper wires.
14. Which is the best method employed for splicing?
15. List out the applications of splicing.
16. How to test the splicing procedure?
17. What should be done for improper or bad splicing?
18. What are the characteristics of good splicing?

